ASBESTOS HEALTH EFFECTS CONFERENCE

SESSION 4. RISK ASSESSMENT METHODS PANEL DISCUSSION

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TOPIC: RISK ASSESSMENT OF NONOCCUPATIONAL EXPOSURES TO ASBESTOS

HOLISTIC OVERVIEW

A. HUMAN EXPERIENCE (Asbestos Epid.)

B. ANIMAL INHALATION

C. " INTRATRACHEAL

D. " INTRAPERITONEAL

E. IN-VITRO

1. Dissolution

2. Cellular responses

} USING: Asbestos, Other Mineral, Vitreous

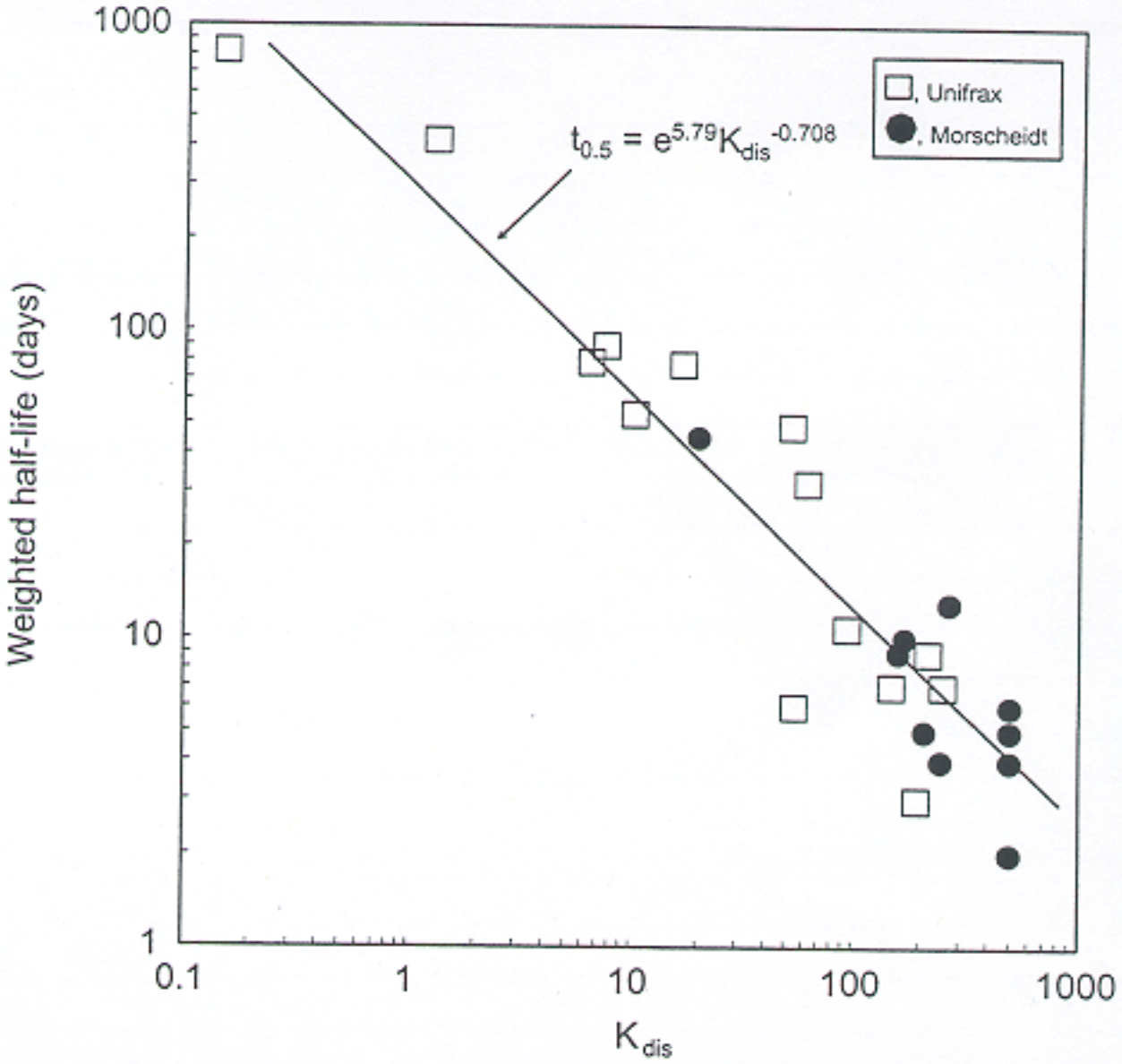


FIGURE 4-1 Relation between in vivo weighted half-life of fibers in short-term inhalation experiments and K_{dis}. Source: Adapted from Maxim et al. (1999a).

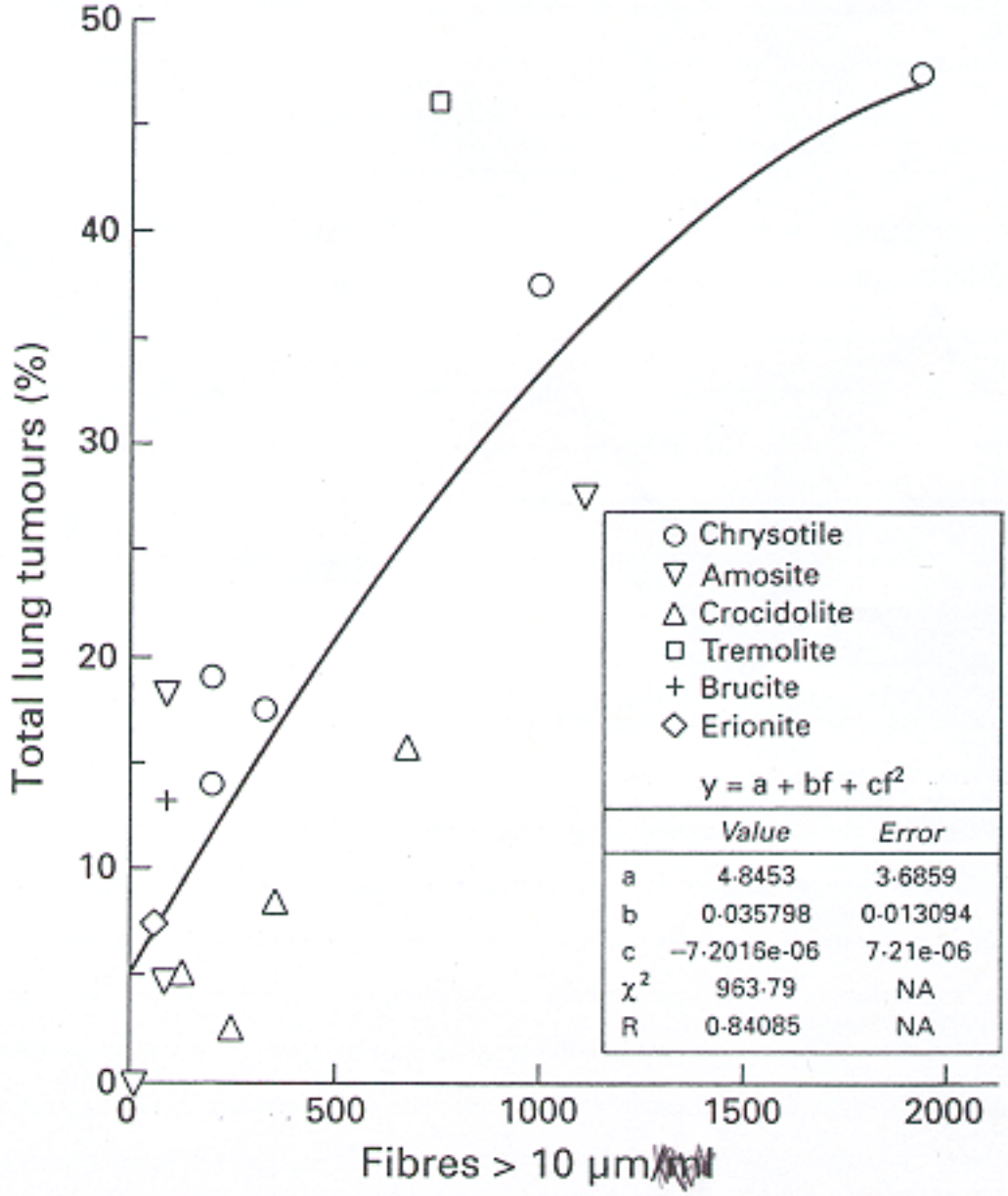


Figure 6 Total incidence of lung tumours in rats chronically exposed by inhalation to various mineral fibres as a function of the concentration of fibres >10 µm in length.

Table 2 Mesotheliomas produced by asbestos in chronic rat inhalation studies

Type of Asbestos	*Source*	*Tumours/animals*
Zimbabwe chrysotile		
Wagner, *et al*[12]—10 mg/m³	UICC	0/44
Davis, *et al*[28]—10 mg/m³	UICC	0/44
— 2 mg/m³	UICC	1/42
Davis, *et al*[29]—10 mg/m³ (1 day/week)	UICC	0/43
Overall		1/169 (0·6%)
Quebec chrysotile		
Wagner, *et al*[12]—10 mg/m³	UICC	4/44
Davis, *et al*[28]—10 mg/m³	Short	1/40
—10 mg/m³	Long	3/40
Hesterberg, *et al*[35]—10 mg/m³	NIEHS	1/69
Overall		9/193 (4·7%)
Davis-Wagner subset		8/124 (6·5%)
Amphiboles		
Wagner, *et al*[12]:		
Crocidolite —10 mg/m³	UICC	2/44
Amosite—10 mg/m³	UICC	0/46
Anthophyllite—10 mg/m³	UICC	2/46
Davis, *et al*[28]:		
Crocidolite—5 mg/m³	UICC	1/43
Crocidolite—10 mg/m³	UICC	0/40
Amosite—10 mg/m³	UICC	0/43
Davis, *et al*[29]:		
Amosite—50 mg/m³ (1 day/week)	UICC	0/44
Wagner, *et al*[11]:		
Crocidolite—10 mg/m³	UICC	1/24
Davis, *et al*[30]:		
Tremolite—10 mg/m³	Korea	2/39
Davis, *et al*[28]:		
Amosite—10 mg/m³	Short	1/42
—10 mg/m³	Long	3/40
McConnell (personal communication):		
Crocidolite—10 mg/m³	UICC	1/69
Overall		13/520 (2·5%)
Davis-Wagner subset		12/451 (2·7%)

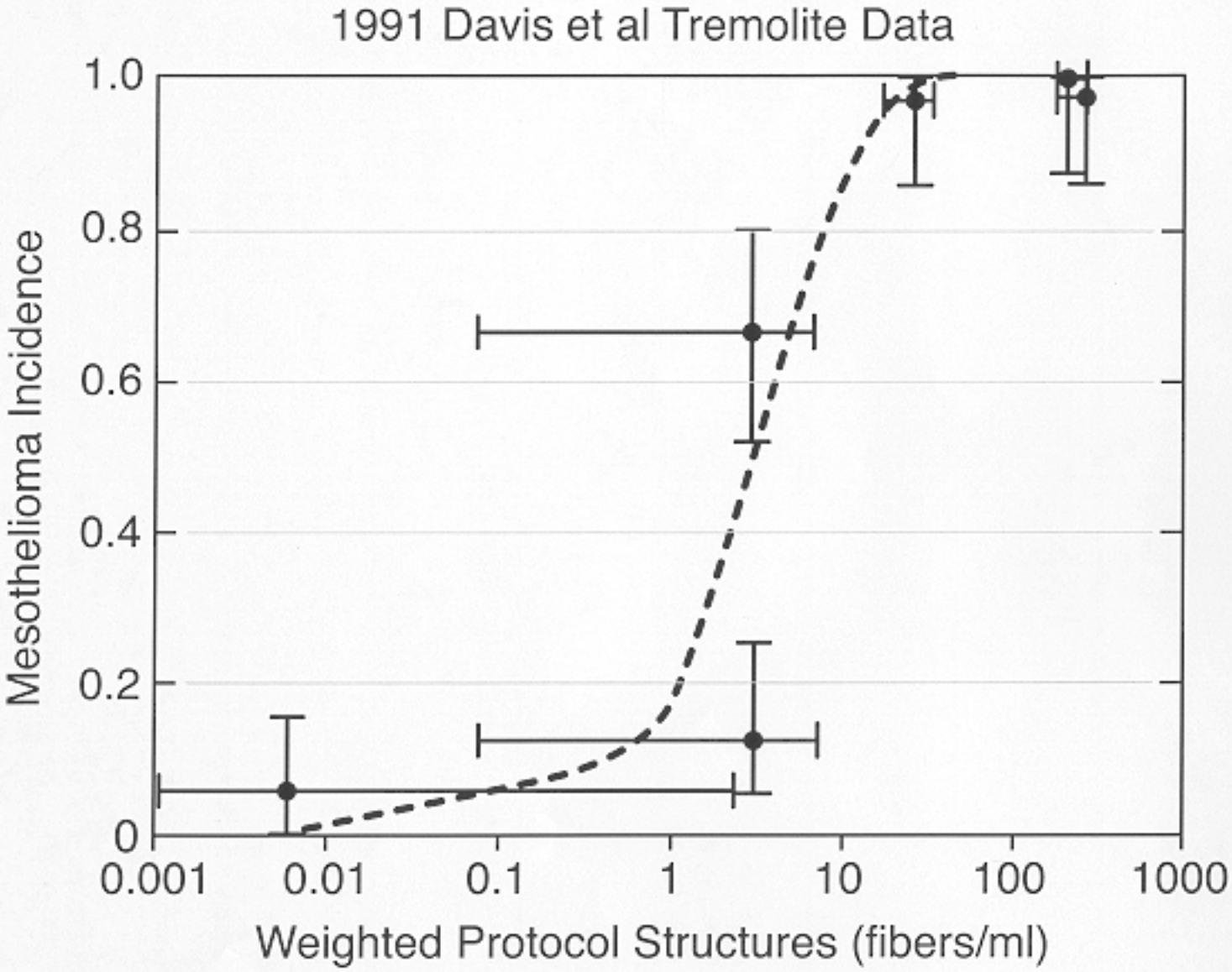
UICC = International Union Against Cancer, Lyon. NIEHS = National Institute of Environmental Health Sciences, Research Triangle Park, NC, USA.

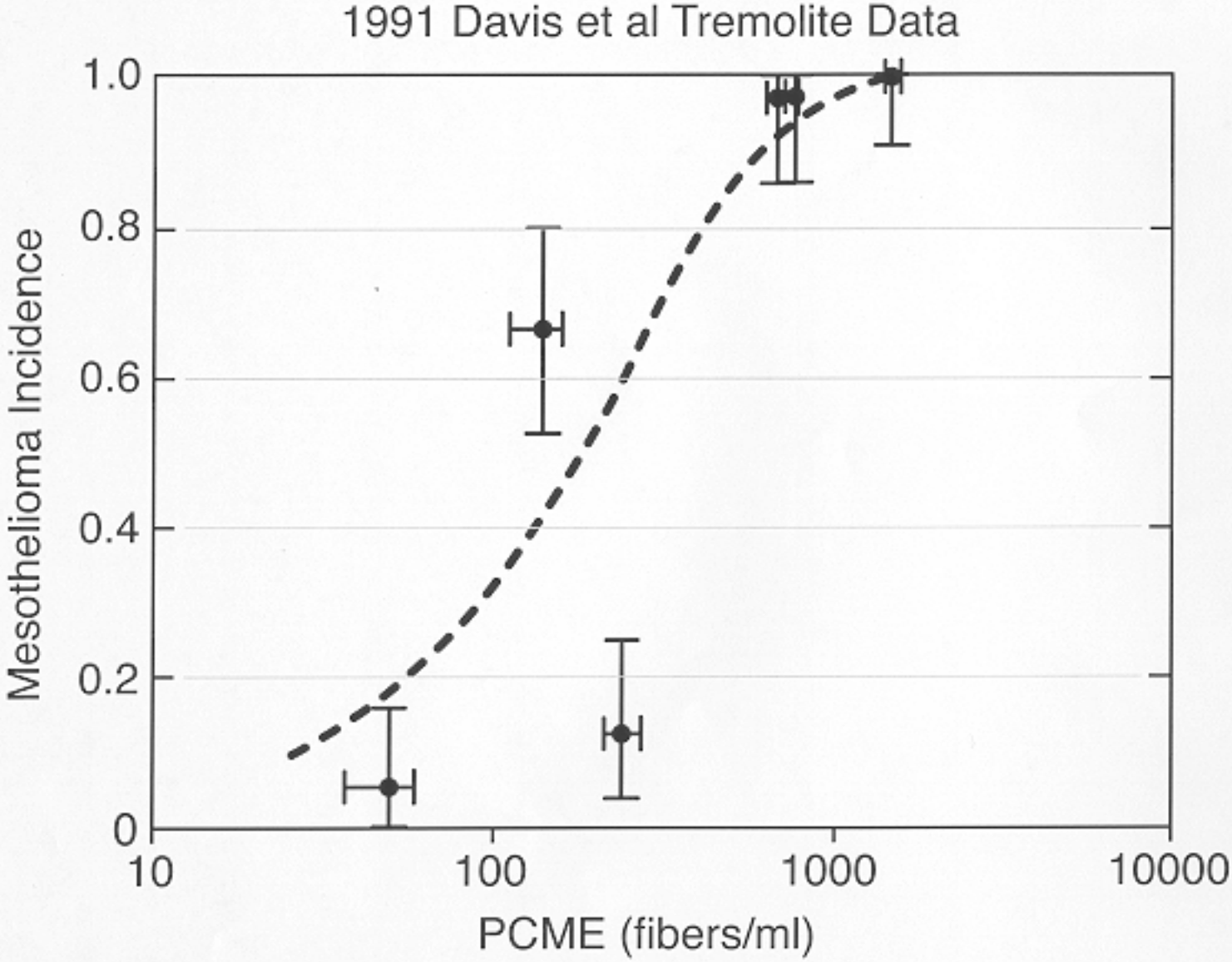
$$C_{opt} = 0.003C_S + 0.997C_L$$

where:

"C_S" is the concentration of asbestos structures between 5 and 10 µm in length that are also thinner than 0.5 µm; and

"C_L" is the concentration of asbestos structures longer than 10 µm that are also thinner than 0.5 µm.


1991 Davis et al Tremolite Data
Mesothelioma Incidence
1.0
0.8
0.6
0.4
0.2
0
0.001
0.01
0.1
1
10
100
1000
Weighted Protocol Structures (fibers/ml)


1991 Davis et al Tremolite Data
Mesothelioma Incidence
1.0
0.8
0.6
0.4
0.2
0
10
100
1000
10000
PCME (fibers/ml)

CONCLUSIONS + HYPOTHESES

(MY PERSONAL SYNTHESIS)

1. LONG FIBERS ($\gtrsim 10\mu m$)

   A. INTERCEPTION DEPOSITION IN LUNG CONDUCTIVE AIRWAYS
   B. NOT CLEARED BY MACROPHAGES
   C. FOR CHRYSOTILE - LESS DISSOLUTION THAN FOR SHORTER FIBERS
   D. STIMULATE ROS
   E. FOR CHRYSOTILE - MORE DISSOLUTION THAN FOR AMPHIBOLES

∴ LONG FIBER CONCENTRATION (fiber count or surface) IS A CRITICAL DETERMINANT OF LUNG CANCER RISK

2. INTERMEDIATE LENGTHS (5-15 μm)

A. MORE LIKELY TO TRANSLOCATE TO MESOTHELIAL SITES

B. NEED TO BE BIOPERSISTANT TO GET TO MESOTHELIAL SITES

C. FIBERS RETAINED IN LUNG TISSUE PROVIDES POOR INDEX OF FIBERS THAT TRANSLOCATE.

∴ INTERMEDIATE LENGTH FIBER CONCENTRATION MAY BE A CRITICAL DETERMINANT OF MESOTHELIOMA RISK

3. SHORT LENGTHS (< 5μm)
NOT DIFFERENT FROM
OTHER (NON-FIBROUS) SILICATE
MINERALS, i.e., A NUISANCE
DUST

4. INTERMITTENCY OF EXPOSURE AND DOSE

A. SHORT OF DUST OVERLOAD

(NOT TO BE EXPECTED FOR ENVIRONMENTAL EXPOSURES)

NOT LIKELY TO AN IMPORTANT INFLUENCE ON DEPOSITED DOSE

B. DOSE IS NOT INTERMITTENT FOR DEPOSITED LONG AMPHIBOLE FIBERS

C DOSE CAN BE INTERMITTENT FOR CHRYSOTILE FIBERS

∴ INTERMITTENT EXPOSURES TO CHRYSOTILE IN ENVIRONMENTAL SETTINGS IS UNLIKELY TO REPRESENT A SIGNIFICANT CANCER RISK

5. ENVIRONMENTAL MONITORING ISSUES

A. HISTORIC MEASUREMENTS

1. Midget Impinger Dust Counts
2. PCM Fiber Counts
3. TEM - All Fibers - Counts
4. TEM - Gravimetric Estimation
5. TEM - PCME

B. RECOMMENDED MEASUREMENTS

TEM - Characterization of each fiber >5μm in length by:

1. Length
2. Thickness
3. Composition (xrd)

C. EXPOSURE RECONSTRUCTION

e.g. Quebec, Charleston

1. Airborne chrysotile and tremolite fibers
2. Source of Charlston chrysotile (Thetford or Asbestos ?)

6. Research Opportunities

1. Comparative Toxicity Studies using length and diameter specific fibers
   (Cite NIOSH Posters and CIIT Work)

2. Collection of Data on Background, Environmental and Occupational Exposures To Airborne Fibers and Determination of Exposure Index According to Empirical Health Relevent Index Developed by Berman and Crump

Southdown Quarry Study
Summary of Possible Study Tasks
NJDEP Expert Panel

Phase 1: Preliminary Investigation

Task 1: Complete simple ranking of sources at the Quarry.
Based upon existing emission inventories or information from Southdown.

Task 2: Complete Characterization of Protocol structures Concentrations in Southdown Marble.
From existing NJGS core data with re-analysis of cores and/or from further core sampling on site as necessary (Task 7).

Task 3: Conduct A Reasonable Worst-Case Assessment of Exposure
Model-based, using emission estimates from Tasks 1 and 2, and reasonable worst-case assumptions for dispersion parameters.

Task 4: Conduct a Study of House Dust and Soil.
Measurement of protocol structure concentration in accumulated household dust and in soil in and around the community.

Task 5 Conduct a Study of Outdoor and Indoor Airborne Protocol Structure Concentrations.
Short-term (3-6 weeks) sampling in conjunction with known and typical operating activities at Southdown Quarry, and controlled typical in-home activities.

Task 6. Perform a summary risk characterization.
Based on the results of Tasks 1 - 5 to determine whether the results indicate clearly that a significant risk does or does not exist resulting from Quarry emissions.

Phase 2: Quantitative Characterization of Transport and Exposure

Task 7: Detailed horizontal and longitudinal sampling and characterization of Southdown Marble
With detailed measurements, providing more definitive results than Task 2, if necessary.

Task 8: Realistic Protocol structures Transport and Refine Modeling.
With refined emissions data and site-specific meteorologic data.

Task 9: Conduct Long-Term Indoor/Outdoor Air Sampling at Selected Residences.
Approximately 6 months of sampling to include seasonal and quarry production variability.

Task 10: Perform detailed risk characterization.
Based on the results of Tasks 5, 6, and 7 to determine risk levels associated with Quarry operations and to serve as a guide to further Agency actions.